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ABSTRACT

This competency-based curriculum unit on maintaining the landscape is one of five developed for classroom use in teaching the landscape/nursery area of horticulture. The five sections are each divided into teaching content (in a question-and-answer format) and student skills that outline steps and factors for consideration. Topics covered include watering plants, mulching plants, directing plant growth, pruning the landscape, and mowing the landscape. A list of references precedes a section containing visual aids, student skill checklists, and student activities, such as field trips, handouts, discussion activities, worksheets, crossword puzzles, hands-on experiences, tests, and quizzes. Answer keys are provided. (YLB)

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Maintaining The Landscape

Competency Based Teaching Materials in Horticulture

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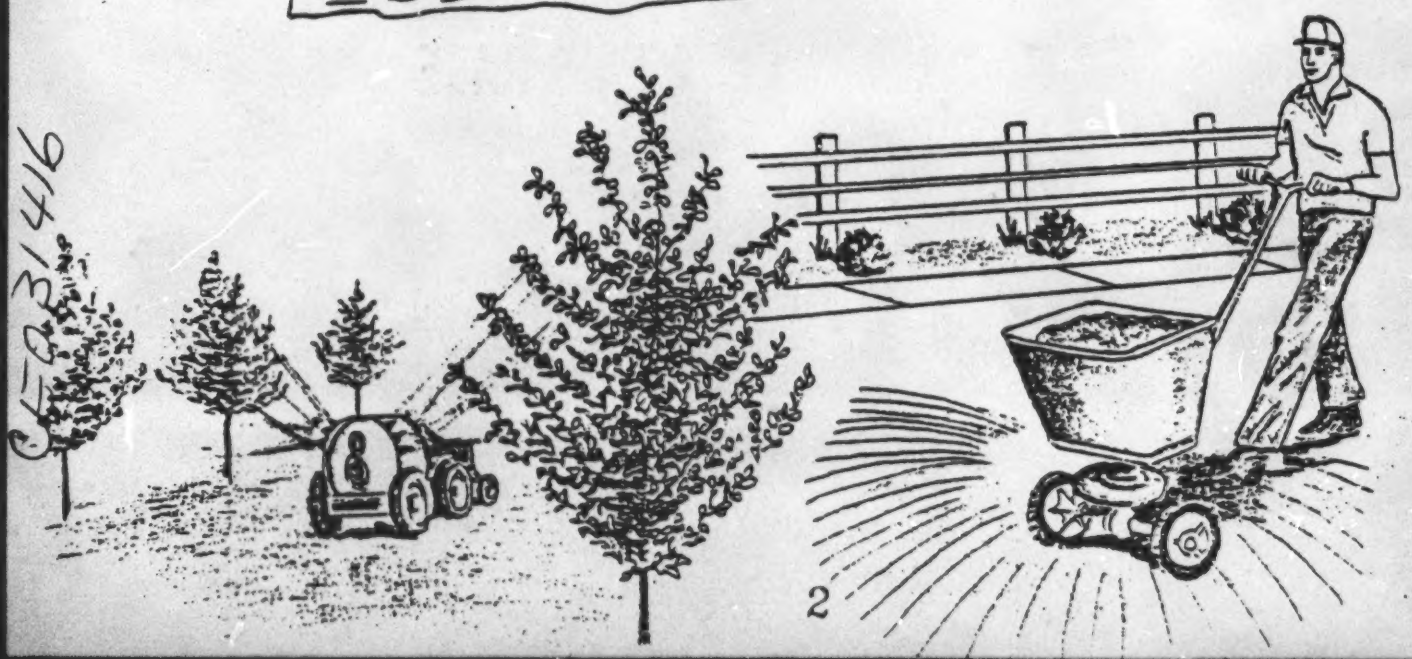

Listed below are competency based curriculum units developed for classroom use in teaching horticulture. All units are indexed and include teaching content, references, student activities, a skill check list, and visual aids.

LANDSCAPE/NURSERY Tree Identification Developing a Landscape Plan Implementing the Landscape Plan Maintaining the Landscape Nursery Propagation	GREENHOUSE PRODUCTION & MANAGEMENT Controlling the Greenhouse Environment Greenhouse Soils Foliage Plants Propagation Sales Cut Flower Production Bedding Plants
TURF AND LAWN SERVICES Identification of Turf Grasses Soils and Fertilizers Planting Turf Grasses Insects and Diseases	VEGETABLE PRODUCTION Identification of Cool Season Vegetables Identification of Warm Season Vegetables Vegetable Production Insects, Diseases, and Weeds
FRUIT PRODUCTION (In progress)	

ACKNOWLEDGEMENT

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MAINTAINING THE LANDSCAPE

Contents

WATER PLANTS 1

Basic types of connectors--their uses; methods of watering, water requirements

MULCH PLANTS 3

Types, functions, benefits, lasting qualities, application rates

DIRECT PLANT GROWTH 5

Straighten, train, selecting a leader, corrective branching

PRUNING THE LANDSCAPE 7

Purposes, when to prune, precautionary steps, necessary tools, plant needs, topiary work, shaping shrubs/trees, large branch and undesirable wood removal, wound treatments, dressing the cut

MOWING THE LANDSCAPE 11

Mower types and sizes, safety measures, basic operations of the mower, maintenance of equipment, lawn area preparation before mowing, cutting methods, cutting heights, seasonal influences on mowing

REFERENCES 17

STUDENT ACTIVITIES 18

Maintaining The Landscape

WATER PLANTS

Teaching content: 9 questions; 2 student skills

Question 1 What are the basic types of connectors?

- Male, with threads on the outside
- Female, with threads on the inside

Question 2 How are hoses attached?

- Male inserted into female connector of complementary diameter

Question 3 Are any parts of connectors replaceable with use?

- Washers are replaced as needed or seasonally

Student Skill 1

TAP WATER SUPPLY

Steps	Factors for Consideration
1. Gather materials	1. Hose pieces connected properly
2. Check for washers	2. Replace if needed
3. Attach hose to bib	3. Must be compatible connectors of proper diameter
	4. Keep on hand replacement connectors of proper type and diameter
	5. Keep on hand tools for repair: pliers, knife, waterproof tape
	6. Keep on hand bushings to change diameter from bib to hose

Question 4 Where should water flow outlet be placed?

- Within "saucer" fashioned by soil dam (shrubs and small trees)
- In band at the dripline (large trees)

Question 5 What methods are used to slow water flow and lessen washout at outlets?

- Bubbler at end of hose slows water flow
- Board or brick (any solid obstacle) can act as a deflector of water coming out of hose end

Question 6 How much water is required by plants?

- Average 1-2" every week to 10 days

Question 7 How does soil type affect watering?

- Apply more water to sandy soil (2+")
- Apply less water to loamy soil (1-2")
- Apply least water to clayey soil (1+")

Question 8 How does species affect watering?

- Water-loving plants (e.g. willows, alders, river birch, etc.) require more water.

Question 9 How should water be applied?

- Hose delivery via soil surface
- Root injection into soil
- Foliar spray during heat or drought stress and during movement or installation of transplants

Student Skill 2

DELIVER WATER

Steps	Factors for Consideration
1. Determine plant need	1. Wilt or discoloration can signal need for water
	1a Obvious dry soil indicates need for water
2. Attach hose and connect	2. Compatible connectors are needed
3. Turn on water	3. Use bubbler at hose end or direct stream at some object to reduce speed
	3a Regulate flow
	3b Get water as close to feeder roots as possible via surface location
	3c Root injection is quick but requires apparatus
	3d Foliar application especially good during heat stress and transplanting for temporary relief

MULCH PLANTS

Teaching content: 11 questions; 2 student skills

Question 1 What types of mulch are used?

- Soft mulch (e.g., straw, leaf litter, peat moss, bark) is temporary and decomposable
- Hard mulch (e.g., stones, gravel, brick chips) is more durable

Question 2 What functions do mulches provide?

- Insulates soil against rapid temperature fluctuations
- Retains soil moisture
- Reduces weed infiltration

Question 3 Which type of mulch looks best in a given landscape?

- Soft mulch in rustic and informal settings
- Hard mulch in tailored and formal settings

Question 4 What benefit can mulch be in a design?

- Provides ground pattern
- Defines bed areas
- Sets off plantings

Question 5 What are the types of available mulches?

Alternatives	Factors for Consideration
1. Soft mulch: e.g., pine needles, clippings, bark chips, pecan hulls, etc.	- Decomposable Soft underfoot Natural looking Flammable Insulating
2. Hard mulch: e.g., stone, sand	- Harsh looking Durable Formal

Question 6 When is mulch applied?

- Fall, after hard freeze
- Late spring, after warm-up

Question 7 When is mulch removed?

- Spring, after last frost

Question 8 When should mulch be replenished?

- Soft mulch as it decomposes
- Hard mulch as it disperses

Question 9 How is mulch applied?

- Evenly to depth of 1-2" for hard mulch
- Evenly to depth of 2-4" for soft mulch
- Over 4-6 mil polyethylene

Student Skill 1

APPLY MULCH

Steps	Factors for Consideration
1. Gather tools	1. Rakes and shovels for spreading mulch
2. Spread mulch evenly	2. Water dry mulch material that tends to blow away during application
3. Contain mulch	3. Use 4-6 mil polyethylene if desired in small areas. Problem of dampness and slime underneath, however.
	4. Even out depth as needed
	5. Use headers or edging to keep mulch in proper places

Question 10 How is mulch used in controlling weeds?

- It physically smothers the weeds
- Addition of pre-emergent herbicides to mulch
- Germinating weeds root shallowly

Question 11 How is mulch cleaned?

- Rake and broom
- Vacuum sweepers
- High velocity blowers

Student Skill 2

MAINTAIN MULCH

Steps	Factors for Consideration
1. Control weeds	1. Apply pre-emergent herbicide according to manufacturer's directions
2. Clean mulch	2a Use rakes or brooms on large particles or heavy mulch 2b Use vacuum sweeper or high velocity blowers
3. Replenish mulch	3. Add new mulch as need arises
4. Keep mulch in place	4. Repair or replace edging to maintain limits on mulch

DIRECT PLANT GROWTH

Teaching content: 9 questions; 2 student skills

Question 1 How can leaning plants be straightened?

- Spading and reposition leaner and fasten to stakes
- Use of guy wires, turnbuckles, and anchors

Question 2 How quickly can a leaning plant be brought to the vertical?

- Small trees and young shrubs, replant immediately
- Large trees, gradually straighten over several years

Question 3 Which trees form leading trunks naturally?

- Upright conifers (e.g., pine, spruce, fir, larch) develop leaders

Question 4 Should all trees be made to establish a leading tip?

- Only upright conifers and certain excurrent deciduous trees (e.g., pin oak, fastigiate types) should be helped to form leaders

Question 5 What methods can be used to train a new leader?

- Wood splints (large pot labels, etc.) attached to main stem and new leader to provide vertical support
- Metal straighteners clamped onto new leader and trunk

Question 6 What considerations are applied to the selection of a leader?

- Choose strong lateral closest to original leader
- Prune out laterals

Student Skill 1

DEVELOP NEW LEADER

Steps	Factors for Consideration
1. Choose heaviest side shoot	
2. Tie up with splint	2. Take care not to break the side shoot
3. Once shoot is in upright position, prune all side branches to prevent flat top.	

Question 7 What means are used in separating close or rubbing branches?

- Wooden separators notched to maintain distance

Question 8 How long must separators be in place?

- Until branches hold new positions; perhaps up to several years.

Question 9 What other methods are used?

- Selection and pruning out of the weaker branch
- Use of screw eyes, cabling and/or rods to reposition branches

Student Skill 2

CORRECT BRANCHING

Steps	Factors for Consideration
1. Major scaffold branches spaced at least 8" apart and preferably 18-24"	1. Scaffolds too close will have fewer laterals--results in long, thin branches with little structural strength
2. Radial branch distribution should have 5-7 scaffolds along trunk	2. Perfect spiral rotation around trunk not necessary
3. Prevent one branch from growing directly over another	3a Top branch suffers competition for water/nutrients; the lower one shaded out 3b Remove less desirable branch

PRUNING THE LANDSCAPE

Teaching content: 21 questions; 3 student skills

Question 1 When is the best time to prune?

- Primarily when the plant is dormant--late fall, early spring
- Immediately after a flowering shrub has finished blooming
- Before a time of active growth when wound will heal quickly
- As soon as possible in the case of broken limbs or injured bark

Question 2 What are the 4 objectives of pruning?

Alternatives	Factors for Consideration
1. Control growth	- Size, density of plant, direction of growth, form
2. Develop strong framework	
3. Maintain desired cultivar	
4. Remove undesirable plant parts	- Dead wood, disease/insect infested wood, storm damage, crossing branches, suckers & watersprouts, girdling roots

Question 3 What are the common pruning tools and their uses?

- Hand pruning shears are used to cut twigs and branches up to 3/4"
- Lopper shears with long handles are used to cut branches up to 1 1/2"
- A variety of saws are used to trim large branches
- Extension poles provide reach to prune up to 12-14 feet from ground

Question 4 What precautions should be taken when pruning?

- Stand so that cut wood will not fall on you
- Alert persons nearby that pruning is being done
- Keep tools in scabbards, holsters or other containers when not in use

Question 5 What needs to be known about plants in order to prune them properly?

- The natural growth habit of plants should dictate pruning pattern
- The landscape use of plants, whether as a screen, hedge, windbreak, or specimen

Question 6 What is shearing and when is it used?

- Trimming plants uniformly to achieve a desired shape
- Used for shaping formal hedges
- Used for fanciful or geometric shapes in topiary work

Question 7 What is pruning and when is it used?

- Removing twigs and branches selectively to achieve a healthy, vigorous plant without destroying natural shape
- Used in trimming most shrubs and trees informally

Question 8 When is radical pruning done?

- Radical or corrective pruning is done when plant has been neglected and lost its shape as a landscape specimen
- When plant needs rejuvenation or has outgrown a space

Question 9 What is topiary work?

- Shaping plants by careful shearing to desired forms

Question 10 Where is topiary practiced?

- In formal display gardens, private and public
- In demonstration plots associated with arboreta or botanic gardens
- In Europe more than in America

Student Skill 1

SHAPE A SHRUB OR TREE

Steps	Factors for Consideration
1. Remove portions that distort natural shape	1. Watch for suckers from base
2. Remove older wood at base of shrub	2. Watch for watersprouts--upright vertical elements from horizontal stems
3. Selectively remove ends or tips	3. Open up the plant to allow replacement of old stems by new
	4. Remove to an outward directed bud so new growth flares away from center
	5. Do not shear unless plants constitute a formal clipped hedge

Question 11 Aside from shaping, what other purpose does pruning serve?

- To remove dead and decaying wood
- To remove mechanically damaged tissue
- To remove bent or broken limbs or roots
- To remove diseased tissue such as cankers, galls, and pest-infested parts

Question 12 What is an indicator of poor pruning practice?

- Leaving stubs of branches behind ("bird perches")

Question 13 How can "bird perches" be avoided?

- Use scissors-type pruners and cut close to the major stems

Question 14 Why be concerned about "bird perches"?

- Stubs provide entry for disease organisms and insects

Question 15 What sound branches should be removed?

- Older branches should be removed to allow younger ones to replace them
- Crossing branches that detract from the shape or that arise at awkward angles
- Branches that rub against other more desirable branches

Question 16 What pruning is sometimes required of underground parts?

- Removal of a root or roots that are growing in such a way as to strangulate other roots or the basal portion of a main stem

Student Skill 2

REMOVE UNDESIRABLE WOOD

Steps	Factors for Consideration
1. Cut out damaged and dead wood	1. Fingernail test: if doubtful whether wood is alive, scrape very small portion of bark. If yellowy green or green under, wood is alive
2. Cut out rubbing limbs and crossovers	2. Eliminate possible sources for future infection by anticipating "rubbers" and crossovers
3. Cut out girdling roots	3. In cases of decline, check to see whether wayward roots are strangling the trunk

Question 17 What is the distinction between sound and necrotic tissue?

- Sound wood can heal over
- Necrotic tissue is dead and decaying, not capable of healing

Question 18 What can be done to encourage healing of wounds?

- Remove all discolored, decayed tissue down to sound, light-colored wood
- Use sharp knife or other tools to obtain a smooth clean cut
- Shape the cut area in the form of an ellipse (football shape)

Question 19 How can the spread of diseases be controlled during pruning operations?

- Dip or wipe all tools into 70% ethanol or 10% liquid bleach solution after all cuts on diseased wood
- Limit pruning operations to dry weather
- Burn all diseased or infested wood

Question 20 What parts of wound treatment are effective and useful?

- Disinfestation of the wound tissue with 70% ethanol or 20% bleach can control certain microbes
- Painting with orange shellac

Question 21 Are any current practices controversial today?

- The use of asphaltum products, creosote products, or opaque paints are of doubtful value and may even be contraindicated
- Wrapping wounds or closing them up away from light may hinder healing and encourage microbial activity
- Use paints as cosmetic covering if wounds are unsightly

Student Skill 3

DRESS CUT

Steps	Factors for Consideration
1. Make smooth elliptical cut	1. Remove all dead tissue down to sound healthy wood
2. Swab with 70% ethanol or 20% bleach	2. Make sure all cut edges are treated to point of runoff
3. Use wound paint	3a Allow to dry 3b Use only if wound is unsightly 3c Paint unnecessary as a barrier to disease

MOWING THE LANDSCAPE

Teaching content: 27 questions; 2 student skills

Question 1 Regarding cutting action, what are the two basic mowers?

- Scissors type: reel, sidebar
- Impact (knife) type: rotary, flail

Question 2 Regarding operation, what are two basic mowers?

- Hand operation or manual
- Power driven

Question 3 Which type of mower is best for a given lawn?

- Reels used for fine, close-cropped turf on smooth ground
- Sidebar used on ditches, roadside, rough ground
- Rotary used on flat to sloping cleared ground
- Flail used on flat to sloping rubbly ground

Question 4 Which size mower is best?

- On lawn less than 2M (2,000 ft^2) hand-operated reel (19") or walk-behind power mower reel or rotary (22")
- On lawn greater than 2M sit-down power mower reel or rotary (24"-26")
- On larger scale lawns sit-down power mower that cuts a several-foot swath

Question 5 Which mower is best for a given grass?

- Reels for low cropped, fine-textured turf on golf course
- Rotaries for higher cut, coarse grass, rougher terrain, weedy lawns
- Flails and sidebars for strong, uneven ground and coarsest grass

Question 6 What are considerations regarding the turf to be mowed?

- The area to be mowed
- The contour of the ground surface

Question 7 How does the area influence mowing?

- Helps to determine whether manual or powered mower should be used.

Question 8 When is best to use a manual vs. a powered mower?

Alternatives	Factors for Consideration
1. Manually operated	- Requires some stamina Useful on small patches Useful in tight or restricted situations Energy conservative Absolute control Cheaper initially and easier to maintain
2. Fuel powered and operated	- Requires confidence with power machines Useful on larger areas Expends fuel (energy consumptive) Greater potential hazard More expensive initially and more expensive to maintain

Question 9 When is best to use a narrow vs. medium vs. wide cutting mower?

Alternatives	Factors for Consideration
1. Small: 18" walk-behind or power mower	- Single area up to 60 x 135 ft. Restrictive spaces Unusual obstacles: terraces, raised beds, etc.
2. Medium: 21" walk-behind or power mower	- Single area up to 100 x 135 ft.
3. Large: 25" and rider mower	- Single area in excess of 100 x 135 ft.

Question 10 How does topography influence mowing?

- Helps to determine specific type of mower to be used.

Question 11 How do reel, rotary, flail and sidebar mowers differ?

Alternatives	Factors for Consideration
1. Reel	- Best on smooth even grades Used on fine textured grasses such as bents Gives "precision" cut Used on golf greens for very close cut
2. Rotary	- Good on moderately smooth grades Generally used for most turf grasses Can "kick" up stones and other obstacles
3. Flail	- Used on rough terrain Said to be safest mower Gives moderate level cut
4. Sidebar	- Used on waste ground, road banks, and less readily accessible areas Used on coarse grasses and weedy areas

Question 12 What are appropriate safety measures to take before mowing?

- Check for proper adjustment of blade(s)
- Check for secure (tightened) parts
- All controls in neutral mode
- Fill gas and oil to proper levels
- Clear area of obstacles
- Dress properly--sturdy shoes, trousers, no scarves or loose-fitting clothes

Question 13 What are appropriate safety measures to observe during mowing?

- Stop machine before dismounting
- Allow engine to cool somewhat before filling gas tank
- Disengage blades and stop before clearing when clogged

Question 14 What are the basic operations of the mower?

- Starting: controls in neutral, follow manufacturer's manual
- Maneuvering: understand limits of turn and speed on proper cutting technique
- Mow on steep slopes on the contour (perpendicular to the fall line), never up and down
- Stopping: follow manufacturer's manual. Disengage blade; stop (choke motor). Engage gears. Dismount.

Student Skill 1

OPERATE MOWER

Steps	Factors for Consideration
1. Controls in neutral	
2. Start motor	2. Follow manual
3. Engage blades	3. Only when power is separated from blade motion
4. Maneuver mower	4. Follow manuf. instruction
5. Stop mower	5. Follow manual
6. Engage gears	6. Prevent mower from rolling

Question 15 Why check gas and oil levels at each use?

- Reduce wear and tear on motor and attachments

Question 16 Where is the dust filter and when and how should it be cleaned?

- Refer to manufacturer's manual

Question 17 What is the proper condition for the mower blade?

- Reel blades should cut paper readily at knife bed
- Rotary blades should be sharp at forward cutting tip (3-4") and blade should be balanced

Question 18 Where is the spark plug?

- Refer to operator's manual or manufacturer's specs.

Question 19 What precautions should be taken regarding the spark plug?

- Discard and replace a rusted or fouled plug with new one
- Cover spark plug with cap (rubber or plastic) against rain
- Replace spark plugs at start of each mowing season

Question 20 How is the blade adjusted?

- In scissors type mowers such as reel and sidebar, the bed knife and blade are moved as a unit with respect to the ground surface
- In impact type mowers such as rotary and flail, the blades are moved closer or farther away from the ground surface

Student Skill 2

CHECK OUT MOWER

Steps	Factors for Consideration
1. Review safety regulations	
2. Check blade height	2. Follow manufacturer's instructions in adjustment
3. Check parts for secure attachment	
4. Check gas and oil	4. Note location and checking procedure in manual
5. Check dust filter	5. Clean as per manual
6. Check blade sharpness and balance	6. Manual
7. Check spark plug	7. Replace seasonally or when plugged by carbon
8. Grease	8. Manual

Question 21 What last minute preparation of the lawn area is required?

- Collect obstacles such as rocks, cans, glass, etc. that can be thrown by mower
- Remove hidden objects that could disrupt machine function (limbs, roots, etc.)

Question 22 How can the area be cut the quickest and most efficiently?

- Avoid recutting by determining direction and turns to be made in advance
- Work from outside in, always discharging clippings into cut areas
- Make wide turns to avoid tearing turf
- Mow across a steep slope

Question 23 How frequently should lawns be mowed?

- As often as required to maintain desired height and not remove more than 30-40% of the leaf blade at any one mowing

Question 24 What heights should be maintained?

- Different species require cultivation at different heights

Question 25 What are the alternative cutting heights?

Alternatives	Factors for Consideration
1. Low: 0.4-1"	- Cool season grasses such as bents Warm season grasses such as Bermuda, zoysia and dichondra All fine-textured grasses
2. Medium: 1-2"	- Cool season grasses such as bluegrass, fine fescues, and perennial ryegrass Warm season grasses such as centipede and carpet Medium-textured grasses
3. Tall: 2-3"	- Warm season grasses such as Bahia and St. Augustine Coarse-textured grasses - All grasses do best when cut higher during stress from heat, drought, or disease - Transitional and most warm season grasses respond best to low to medium blade heights, depending on stresses - Reclamation and coarse grasses can be cut at 4" or higher if desired as erosion control

Question 26 What are the seasonal influences on mowing?

- Cool season grasses need more frequent cutting during spring and fall: temp. range 60-75°F.
- Warm season grasses need more frequent cutting in summer: temp. range 80-95°F

Question 27 What are the other influences on mowing?

- Cool wet weather causes cool-season grasses to grow rapidly
- Warm or hot wet weather causes warm season grasses to grow rapidly
- Drought stress reduces growth of grasses
- Higher fertility causes more grass growth
- Diseases and pests reduce grass growth

MAINTAINING THE LANDSCAPE

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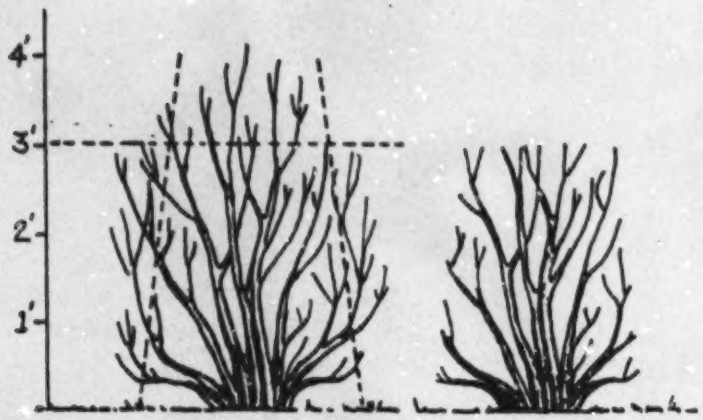
STUDENT ACTIVITIES

PRUNING DECIDUOUS SHRUBS



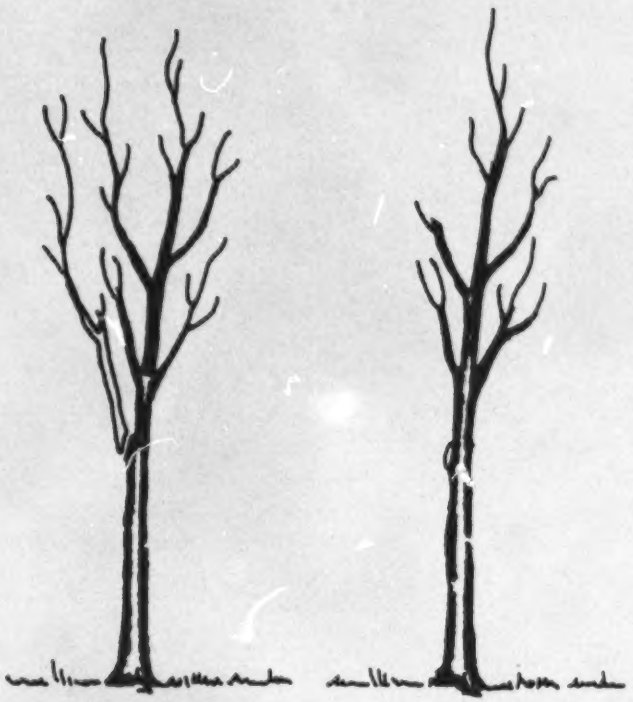
The first step in pruning a hedge is to establish lines at the proper angle for cutting (at left). The same hedge immediately after pruning is shown at right.

Spring's first growth (left) and hedge in full foliage indicating shape (right).

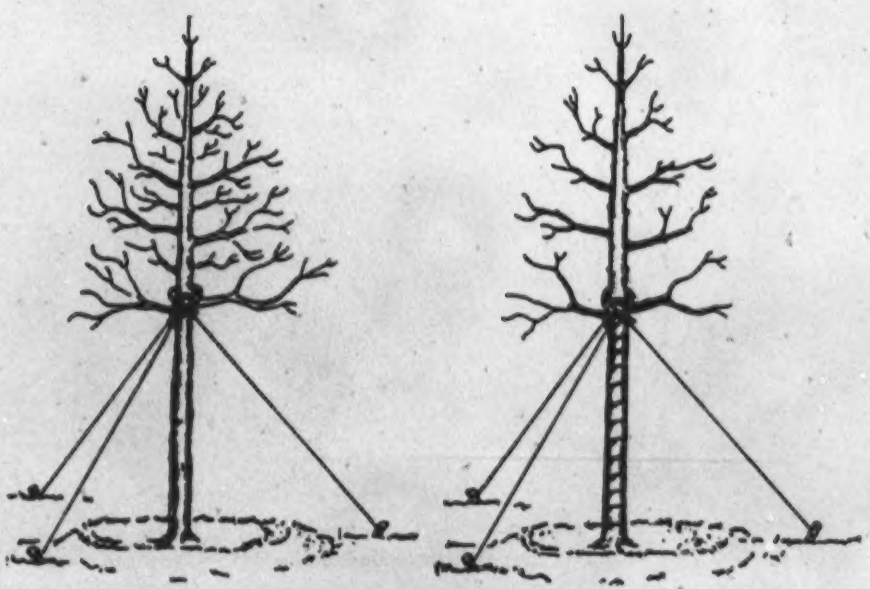
Hedge immediately after incorrect pruning (at left). Hedge in full foliage showing leggy, sparse condition in the lower part (at right).

F.A. Giles, W.R. Seifert, Pruning Evergreens and Deciduous Trees and Shrubs, Urbana, IL: Cooperative Extension Service, Circular 1033, 1971.

PRUNING OF YOUNG SHADE TREES



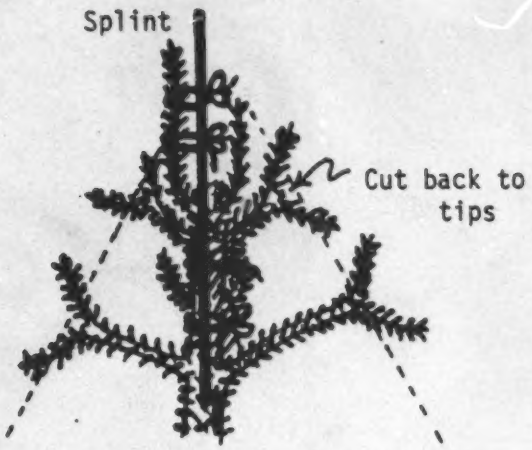
A young shade tree developing a double leader (at left). The space indicates the cut to make. The plant after the cut is shown at right.



A newly planted shade tree indicating proper planting, bracing, and pruning cuts to make (at left). Same tree after pruning (at right).

F.A. Giles, W.R. Seifert, Pruning Evergreens and Deciduous Trees and Shrubs, Urbana, IL: Cooperative Extension Service, Circular 1033, 1971.

CREATING A NEW LEADER

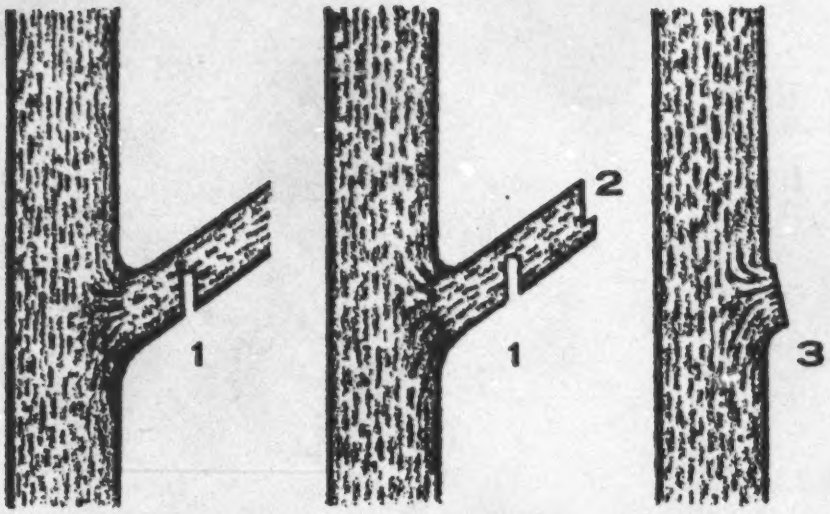


TO CREATE A NEW LEADER:

- CHOOSE STRONGEST LATERAL CLOSEST TO THE ORIGINAL LEADER
- TIE SELECTED LEADER WITH A SPLINT
- ONCE THE SHOOT IS IN AN UPRIGHT POSITION, PRUNE ALL EXCESS LATERALS TO PREVENT A FLAT TOP FROM FORMING.

F.A. Giles, W.R. Seifert, Pruning Evergreens and Deciduous Trees and Shrubs, Urbana, IL: Cooperative Extension Service, Circular 1033, 1971.

STEPS FOR STUB CUTTING



Stub cutting a heavy member to prevent splitting the wood and stripping the bark. Make first cut from below at 1; cut off the limb from above at 2. Then remove the stub with a cut at 3.

STUB CUTTING REQUIRES THREE SAW CUTS.

1. Make first cut on the lower side of the limb, 1 to 2 feet farther out on the limb than the final cut will be made. Saw upward about half way through the limb, or until the wood pinches the saw blade.

2. Make the second cut a few inches farther out on the limb. Cut downward from the top until the limb is severed.

3. Finally, saw off the stub. Leave no bark or wood - or only a very narrow ledge - at the top of the cut. A narrow ledge may be left on the base. Make this cut as smooth as you can; smooth it with the chisel, if necessary.

SHORT STUBS THAT ARE NOT REMOVED USUALLY DIE. THESE DEAD STUBS ARE POINTS THROUGH WHICH DECAY FUNGI CAN ENTER THE TREE.

Curtis May, L.R. Schreiber. Pruning Shade Trees and Repairing Their Injuries. Washington, D.C.: U.S. Government Printing Office, Home and Garden Bulletin 83, 1976.

KEY TO PLANT-NUTRIENT DEFICIENCY SYMPTOMS

Element Deficient

A. Parasitic and virus diseases disseminated by bacteria, fungi or virus entities (excluded from present discussion).

A. Non parasitic troubles; never infectious; caused by element deficiencies.

1. Older or lower leaves of plant mostly affected; effects localized or generalized.

a. Effects mostly generalized over whole plant; more or less drying or firing of lower leaves; plant light or dark green.

1) Plant light green; lower leaves yellow, drying to light brown color; stalks short and slender if element is deficient in later stages of growth ..... Nitrogen

2) Plant dark green, often developing red and purple colors; lower leaves sometimes yellow, drying to greenish brown or black color; stalks short and slender if element is deficient in later stages of growth ..... Phosphorus

b. Effects mostly localized; mottling or chlorosis with or without spots of dead tissue on lower leaves; little or no drying up of lower leaves.

1) Lower leaves mottled or chlorotic, with or without dead spots; leaf margins sometimes tucked or cupped upward or downward.

a) Mottled or chlorotic leaves typically, may redden, as with cotton; sometimes with dead spots; tips and margins turned or cupped upward; stalks slender ..... Magnesium

b) Mottled or chlorotic leaves with large or small spots of dead tissue.

i) Spots of dead tissue small, usually at tips and between veins, more marked at margins of leaves; stalks slender ..... Potassium

ii) Spots generalized; rapidly enlarging, generally involving areas between veins and eventually involving secondary and even primary veins; leaves thick; stalks with shortened internodes . Zinc

2. Newer or bud leaves affected; symptoms localized.

a. Terminal bud dies, following appearance of distortions at tips or bases of young leaves.

1) Young leaves of terminal bud at first typically hooked, finally dying back at tips and margins, so that later growth is characterized by a cut-out appearance at these points; stalk finally dies at terminal bud ..... Calcium

1) Young leaves of terminal bud becoming light green at bases, with final break down here; in later growth, leaves become twisted; stalk finally dies back at terminal bud ..... Boron

b. Terminal bud commonly remains alive; wilting or chlorosis of younger or bud leaves with or without spots of dead tissue; veins light or dark green.

1) Young leaves permanently wilted (wither-tip effect) without spotting or marked chlorosis; twig or stalk just below tip and seedhead often unable to stand erect in later stages when shortage is acute ..... Copper

2) Young leaves not wilted; chlorosis present with or without spots of dead tissue scattered over the leaf.

a) Spots of dead tissue scattered over the leaf; smallest veins tend to remain green, producing a checkered or reticulated effect ..... Manganese

b) Dead spots not commonly present; chlorosis may or may not involve veins, making them light or dark green in color.

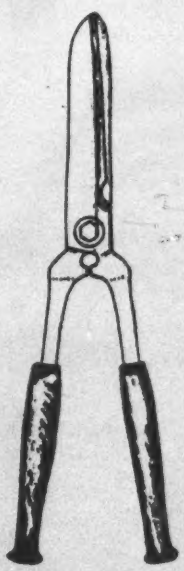
i) Young leaves with veins and tissue between veins light green in color ..... Sulphur

ii) Young leaves chlorotic, principal veins typically green; stalks short and slender .... Iron

J. E. McMurtrey, Jr., Diagnostic Techniques for Soils and Crops. The American Potash Institute, 1948.

Tools

Hand Pruners
Use on stems up to ¾ inches in diameter. They come in two main types:
☐ Scissor-style pruners have sharpened blades that overlap in making the cut.
☐ Anvil-style pruners have a sharpened top blade that snaps onto a flat plate of softer metal. Though lighter and easier to handle than the scissor type, this pruner always crushes the bark on the anvil side and cannot cut as close as the scissor type.



Hedge shears
Use on all hedges except those with protruding stems over ½ inches in diameter. To prevent the foliage from slipping away, buy the kind that has one blade notched.

Pruning knife
Use to smooth the rough edges on the trunk or large branch after making a large cut. Smoothing the edges helps the tree heal more quickly.

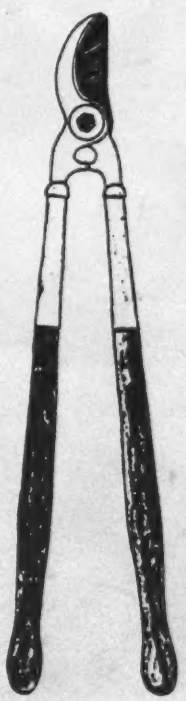
Narrow curved pruning saw
Use on branches up to 2 inches in diameter where the branches are too densely crowded to effectively wield a wide blade saw.

Electric hedge shears
Use on all hedges except those with stems protruding over ¾-inches in diameter. Because manual shears are tiring after prolonged use, the electric shears quickly become a welcome relief. They are faster, easier to use and allow greater accuracy of line.

Extension saw
Use on out-of-reach branches up to 2 inches in diameter. The curved blade operates like the narrow curved pruning saw.

Wide blade saw
Use on the largest limbs. The forward-angled teeth work like a carpenter's saw.

Double-edged saw
Use on larger branches. One side of this saw has small teeth that cut when the saw is pushed, and is used for small branches and deadwood. The other side has coarse teeth that cut larger branches on both strokes.



Lopping shears
Use on branches up to 1¼ inches in diameter. Heavy duty loppers are available for cutting through wood 1¾ inches thick.

Chain saw
Use on branches over 3 inches in diameter. Although chain saws eliminate much hard work, they should be operated very carefully.

Wood rasp
Use to smooth the rough edges on the trunk or large branch after making a large cut. Many people found the wood rasp somewhat easier to use than a pruning knife.

Extension loppers
Use on out-of-reach branches that are no more than 2 inches thick.

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Deficiency Symptoms of Some Plant Nutrients

Plant	Nitrogen — N	Phosphorus — P	Potassium — K
Azalea	Pale green leaves, red color, poor branching.	Slow, dark green growth, poor bud set.	Slow growth, premature dropping of old leaves.
Bedding Plants	Leaves and plants yellow and small.	Leaves dark green, may turn purple with tip burn.	Tips of older leaves chlorotic; may spread over entire leaf.
Begonia semperflorens	Slow, pale growth; leaves and stems of colored cultivars turning red.	Growth stunted, no branching.	Necrosis on leaf margins, later turn brown and shed.
Calceolaria and Cineraria	Older leaves yellow-green.	Slow, dark green growth.	Young leaves yellow-green, older leaves show large necrotic spots, turn brown or black.
Carnation	Light color, small flowers, lack of "pig-tail" curl of leaf tips and foliage bloom.	Slow, dark green growth.	Lower leaves turn brown and die, increased susceptibility to disease, weak stems in mid winter.
Chrysanthemum	Pale green color contrasting with blue-green of high levels of nitrogen; leaves and flowers small.	Slow, dark green growth.	Leaves become gray-green; slow growth, chlorosis of margins of lower leaves progressing rapidly to necrosis.
Geranium	New growth lighter green; red margins and veins may develop an older foliage, especially at lower temperatures.	Slow, dark green growth, delay in flowering; margins may curl up.	Chlorosis of interveinal areas and margins of lower leaves. New growth may appear dull.
Gloxinia	Smaller leaves, not as dark green.	Slow growth.	Browning of oldest leaves.
Hydrangea	Pale green, smaller leaves.	Not generally found in normal forcing. Young stock may have reduced flower buds.	Marginal necrosis of lower leaves. May be severe and progress to upper leaves. May be confused with hydathode salt burn.
Lily, Easter	Little color change but leaves may be smaller and plants taller.	Not generally found in normal forcing.	Not frequently observed. premature death of lower foliage, especially when plants are crowded.
Poinsettia	Uniform light yellow-green color, more severe on older leaves, slow growth.	Dark green, slow growth, plants stunted, older leaves yellow followed by necrosis.	Chlorosis of interveinal areas of old leaves progressing to necrosis and advancing up the plant.
Rose	Pale green, smaller leaves, increase in blind wood, older leaves may turn bright yellow.	Slow, dark green growth, increase in blind wood, old leaves drop green.	Early loss of older leaves sometimes accompanied by marginal chlorosis, weak stems.
Seedlings	Turn yellow as soon as seed reserves are exhausted.	Slow growth. Seedlings require adequate phosphorus.	Not as critical as N and P.
Snapdragons	Pale green to yellow, small leaves, fewer flowers and side branches. Leaves may bend down.	Slow, dark green growth with younger leaves rolling inward.	Yellowing of leaves reduced growth. May induce Fe deficiency on young leaves with reddish tinge on margins.
General	Pale green to yellow color, older leaves first, often accompanied by red, bronze or purple pigment accumulation, slow growth.	Slow growth often accompanied by purplish pigmentation and darker green foliage. Poor bud or flower formation.	Marginal and interveinal chlorosis beginning on oldest leaves. Reduced resistance to disease.

Calcium — Ca	Magnesium — Mg	Sulfur — S	Iron — Fe
Slow growth, poor root activity. Terminal bud abortion.	Seldom found. Older leaves exhibit interveinal chlorosis and drop prematurely.	Seldom found.	Chlorosis of new leaves, symptomatic or poor root activity or high pH.
Stunted growth, poor roots.	Interveinal chlorosis, premature defoliation.	Pale green leaves, particularly young ones.	Interveinal chlorosis on new growth.
Terminal growth stunted; leaves light green with red margins; poor roots.	Interveinal chlorosis followed ed by necrosis.	Slow growth, leaves dull grayish yellow.	Terminal chlorosis with green veins.
Slow growth, poor roots.	Interveinal chlorosis of older leaves progressing upward.	Slow growth and chlorosis of young leaves.	Interveinal chlorosis of terminal leaves, symptomatic of root damage.
Slow growth, poor root activity; tip burn on young leaves and calyces, sleepy flowers.	Mid-leaves chlorotic with green midribs.	Slow growth, upper leaves become yellow, flowers develop slowly, stems stiff.	Deficiency seldom seen, nutrient requirement low.
Slow growth, terminal buds and leaves may die; poor root activity.	Interveinal chlorosis of newly mature leaves, veins remaining quite green.	Slow growth, upper leaves becoming yellow, veins lighter, tips darker.	Growing tips become yellow to white. Veins remain green longer than interveinal areas.
Slow growth, red pigment at lower temperatures, especially if nitrogen is also low.	Interveinal chlorosis of newly mature leaves. Seldom a problem.	Light green foliage, reduced growth, especially of terminals.	Young leaves chlorotic with veins which may turn white.
Seldom found.	Seldom found.	Seldom found	Seldom found.
Not generally found in normal forcing.	Interveinal chlorosis of newly mature leaves, especially when grown as pink.	New growth light green, more susceptable to mildew.	Chlorosis of youngest leaves, green veins, more common during juvenile growth.
Poor root activity, lower bud count; bud split just prior to opening.	Not generally found in normal forcing.	Not generally found.	Not generally found.
Slow growth sometimes resulting in bud stoppage and poor bract formation, root activity may be poor.	Interveinal chlorosis of newly mature leaves forming a pyramid design around midrib.	Yellowing of topmost leaves.	New leaves chlorotic with green veins, symptomatic of root damage.
Slow growth, poor root activity, increase in blind wood, of terminal growth abortion.	Interveinal chlorosis of older or more newly mature leaves.	Slow growth, upper leaves turning yellow. Seldom observed.	Interveinal chlorosis of new growth, symptomatic of poor root activity.
Seldom limiting.	Seldom limiting.	Almost never limiting.	Almost never limiting.
Poor root activity. May induce Fe deficiency. Bud abortion possible.	Cuping of upper leaves, white necrosis along veins or in small interveinal spots.	Upper leaves become mottled yellow, principal vein turning white on more mature leaves. Flowers pale.	Interveinal chlorosis giving striped effect.
Terminal growth stunted, bud abortion, poor root activity.	Interveinal chlorosis of newly mature or older leaves.	Yellowing of upper leaves, sometimes with lighter veins and reduced growth.	Interveinal chlorosis of youngest leaves, veins slowly becoming white. (In Mn deficiency, veins remain green.)

Cooperative Extension Service of the Northeast States. Nutrition of Greenhouse Crops (5th Edition). New Brunswick, N.J.: Cooperative Extension Service, Rutgers-The State University of New Jersey, May 1980.

Insects	Insecticide[1]	Suggestions[2]
Aphids (NHE-7)	diazinon malathion	Spray foliage thoroughly with force. Repeat as needed.
Bagworms (NHE-6)	carbaryl malathion *Bacillus thuringiensis*	Spray foliage thoroughly. Apply June 15. Later sprays are less effective. For late spraying, use *Bacillus thuringiensis*.
Borers (NHE-8) Bronze birch	dimethoate	Spray trunk and limbs thoroughly in late May and early June. Repeat in 3 weeks. See leaf miner recommendations on insecticide label.
Ash Lilac Peach tree	chlorpyrifos	Spray trunk and limbs in mid-June and repeat 4 weeks later.
Cankerworms (NHE-95)	acephate carbaryl malathion *Bacillus thuringiensis*	Spray foliage when feeding or worms are first noticed in spring.
Eastern tent caterpillars	Same as for cankerworms	Spray when nests are first noticed.
Elm leaf beetle (NHE-82)	carbaryl	Spray as soon as damage is noticed.
European pine shoot moths and Nantucket pine moth (NHE-83)	dimethoate	Spray ends of branches thoroughly in late June for European species and in mid-May for Nantucket species.
Fall webworms	acephate carbaryl diazinon malathion *Bacillus thuringiensis*	Spray when first webs appear; clip off and destroy infested branches or burn out webs.
Galls (NHE-80, 81)		
Elm cockscomb Hickory Maple bladder	diazinon malathion	Spray foliage thoroughly when buds are unfolding. Sprays after galls form on leaves are ineffective.
Hackberry blister	diazinon malathion	Spray foliage thoroughly in late May. Kills psyllids in galls. Sprays after galls form on leaves are ineffective.
Cooley spruce Eastern spruce	diazinon malathion	Apply in late September or October or early spring just before buds swell.
Green-striped mapleworms	Same as for cankerworms	Spray as soon as damage is noticed.
Leaf miners		
Boxwood Hawthorn Oak	diazinon malathion	Spray foliage thoroughly when miners first appear. Repeat treatment in 10 to 12 days.
Birch Holly	dimethoate	Repeat treatment in 3 weeks.
Mealybugs	malathion	Spray foliage thoroughly and with force. Repeat in two weeks.
Mimosa webworms (NHE-109)	acephate carbaryl malathion *Bacillus thuringiensis*	Spray foliage thoroughly when first nests appear (June, July). A repeat treatment may be needed.
Mites (NHE-58)	dicofol	Pay particular attention to underside of leaves. Apply 2 or 3 times at weekly intervals.
Oak kermes	malathion	Spray foliage thoroughly about July 1 to kill the crawlers.
Periodical cicadas (NHE-113)	carbaryl	Spray all branches thoroughly when adults appear. Repeat in 7 to 10 days.
Sawflies	Same as for fall webworms	Spray as soon as worms or damage is evident.
Scale (NHE-100, 114)	diazinon malathion	Spray foliage thoroughly in early April for *Fletcher* and *European elm scale;* in late May for *pine needle* and *sweet gum scale;* in early June for *scurfy, oystershell,* and *euonymous scale;* in early July for *cottony maple, Juniper,* and *dogwood scales;* in mid-July for *spruce bud scale;* and again in early August for *oystershell scale.*
Cottony maple Putnam San Jose Tulip tree	dormant oil diluted according to label	Apply when plants are still dormant in late winter. Do not use on evergreens. For tulip tree scale, a malathion spray in late September or in early spring is also effective.

[1] Use only one insecticide from those listed.
[2] Treatment dates are listed for central Illinois. In southern Illinois apply 2 weeks earlier and in northern Illinois 2 weeks later.

TREE AND SHRUB INSECTS (continued)

Insects	Insecticide[1]	Suggestions[2]
Sycamore lace bugs	acephate carbaryl malathion	Spray when nymphs appear, usually in late May.
Thrips	Same as for aphids	Mainly on privet. Spray foliage thoroughly.
Yellow-necked caterpillars	acephate carbaryl malathion	Spray foliage when worms are small.
Zimmerman pine moths	chlorpyriphos dimethoate	Spray in mid-April or mid-August.

[1] Use only one insecticide from those listed.
[2] Treatment dates are listed for central Illinois. In southern Illinois apply 2 weeks earlier and in northern Illinois 2 weeks later.

Amount of Insecticide Needed for Volume of Spray

	1 gal.	6 gal.	100 gal.		1 gal.	6 gal.	100 gal.
acephate (Orthene) 15.6% E.C.[1]	4 tsp.	1 cup	2 qt.	dicofol (Kelthane) 18.5% E.C.	2 tsp.	4 tbl.	1 qt.
carbaryl (Sevin) 50% W.P.[1]	2 tbl.	¾ cup	2 lb.	dimethoate (Cygon, DeFend)	2 tsp.	4 tbl.	1 qt.
chlorpyrifos (Dursban) 2E.	2 tsp.	4 tbl.	1 qt.	23.4% E.C., 25% W.P.[3]			
diazinon 25% E.C.[2]	2 tsp.	4 tbl.	1 qt.	malathion 50-57% E.C.[4]	2 tsp.	4 tbl.	1 qt.

[1] Do not use on Boston ivy. [2] Do not use on ferns or hibiscus. [3] Do not use on chrysanthemums. [4] Do not use on canaert red cedar. [5] Do not use on flowering crab, sugar maple, redbud, American elm, Lombardy poplar, or cottonwood.
E.C. = emulsion concentrate; W.P. = wettable powder.

LAWN INSECTS

Insects	Insecticide[1]	Dosage per 1,000 sq. ft.[2]	Suggestions
White grubs (NHE-104) Ants (NHE-111)	diazinon 25% E.C. 5% G.	1 cup 2½ lb.	Apply as spray or granules to small area and then water in thoroughly before treating another small area. Grub damage will usually occur in late August and in September.
Ants (NHE-111) Cicada killer and other soiling-nesting wasps (NHE-57, 79)	diazinon 25% E.C. 5% G.	¾ cup 2 lb.	Apply as spray or granules and water in thoroughly. For individual nests pour 1% diazinon in nest and cover with soil.
Sod webworms (NHE-115)	carbaryl 50% W.P. 5% G. diazinon 25% E.C. 5% G. chlorpyrifos 2 E.C. 0.5% G. Aspon 13% E.C.	½ lb. 4 lb. ¾ cup 2 lb. 1½ fl. oz. 5 lb. 1½ cups	As sprays, use at least 2.5 gal. of water per 1,000 sq. ft. Do not water for 72 hours after treatment. As granules, apply from fertilizer spreader. Webworms usually damage lawns in late July and in August.
Millipedes and sowbugs (NHE-93)	carbaryl 50% W.P. diazinon 25% E.C.	½ lb. ¾ cup	Spray around home where millipedes or sowbugs are crawling. If numerous, treat entire lawn.
Armyworms Cutworms	carbaryl 50% W.P. 5% G. chlorpyrifos 2 E.C. 0.5% G.	2 oz. 1 lb. 1½ fl. oz. 5 lb.	Apply as sprays or granules. Use 5 to 10 gal. of water per 1,000 sq. ft.
Chinch bugs	chloropyrifos 2 E.C. Aspon 13% E.C.	1½ fl. oz. 2⅔ cups	Spray infested areas where chinch bugs are present.
Aphids	malathion 50-57% E.C.	1 tbl.	Spray grass thoroughly.
Chiggers	diazinon	1 tbl.	Spray grass thoroughly.
Slugs (NHE-84)	Mesurol 2% bait		Apply where slugs are numerous. Scatter in grass. For use only in flower gardens and shrubbery beds.

[1] Use only one insecticide from those listed.
[2] To determine lawn size in square feet, multiply length times width of lawn and subtract nonlawn areas including house, driveway, garden, etc. Do not allow people or pets on lawn until the spray has dried.
E.C. = emulsion concentrate; W.P. = wettable powder; G. = granules.

Cooperative Extension Service. 1981 Insect Pest Management Guide - HOME, YARD and GARDEN (Revised annually). Urbana,IL: Cooperative Extension Service, Circular 900, 1981.

PESTICIDE DILUTION TABLE

HOW TO USE: When preparing a spray of a desired percentage you need to know only the formulation of the particular product (examples: Kelthane 18.5% wettable powder; Kelthane 18.5% emulsion concentrate). For instance, if you were preparing a 0.5% diazinon solution for spraying the foundation of the home, you would mix 5 tablespoons of diazinon 25% E.C. into each gallon of water. The formulations of insecticides in the table may be purchased from hardware stores, pest control establishments, lawn and garden centers, and other sources. For some jobs, such as spraying outdoors to control flies or mosquitoes, a gallon or more of properly diluted spray is required. To obtain the percent concentration suggested for controlling a particular insect, add the amount of pesticide suggested in the table to one gallon of water. For control of household insects. *Do not* use this table for vegetable, flower, tree, shrub, or lawn insects.

Pesticide formulation	Amt. of insecticide needed per gal. of spray				
	Desired concentration				
	0.03%	0.25%	0.5%	1.0%	2.5%
carbaryl (Sevin) 50% W.P.	..	2 tbsp.	4 tbsp.	8 tbsp.	..
chlordane 45% E.C.	..	..	8 tsp.	5 tbsp.	..
chlordane 72% E.C.	..	..	4 tsp.	8 tsp.	..
diazinon (Spectracide) 25% E.C.	..	..	5 tbsp.	10 tbsp.	..
dicofol (Kelthane) 18.5% E.C.	1½ tsp.	..	..	..	..
malathion 50-57% E.C.	..	..	7 tsp.	4½ tbsp.	10 tbsp.
stirofos 50% W.P.	..	..	4 tbsp.	..	..

(*tbsp. = tablespoon; tsp. = teaspoon*)

Conversion Table for Small Quantities

1 level tablespoon = 3 level teaspoons	1 pint = 2 cups
1 fluid ounce = 2 tablespoons	1 quart = 2 pints or 32 fluid ounces
1 cup = 8 fluid ounces or 16 tablespoons	1 gallon = 4 quarts or 128 fluid ounces

NAMES OF INSECTICIDES

Below is a list of the common names of insecticides used in the preceding tables, followed by the commercial trade name and the chemical name. Some products may be available under a variety of trade names not listed below. Be sure to read the label. The label on the container always lists these products by the common name or chemical name.

Common name	Trade name	Chemical name
acephate	Orthene	O, S-dimethyl acetylphosphoramidothioate
carbaryl	Sevin	1-naphthyl methylcarbamate
chlorpyrifos	Dursban	O, O-diethyl O-(3,5,6-trichloro-2-pyridl) phosphorothioate
DEET	Off, Kik	N, N-diethyl-m-toluamide
diazinon	Spectracide	O, O-diethyl O-(2-isopropyl-4-methyl-6-pyrimidyl) phosphorothioate
dichlorvos	Vapona, DDVP	2,2-dichlorovinyl dimethyl phosphate
dicofol	Kelthane	4,4'-dichloro-a-(tri = chloromethyl) benzhydrol
dimethoate	DeFend, Cygon	O, O-dimethyl S-(N-Methyl carbamoyl methyl) phosphorodithioate
ethyl hexanediol	6-12, Rutgers 612	2-ethyl-1, 3-hexanediol
malathion	Cythion	diethyl mercaptosuccinate, S-ester with O, O-dimethyl phosphorothioate
propoxur	Baygon	O-isopropoxyphenyl methyl carbamate
propyl thiopyrophosphate	Aspon	0,0,0,0-tetrapropyl dithiopyrophosphate
pyrethrin		principally from plant species *Chrysanthemum cinariaefolium*
resmethrin	Chryson, SBP-1382	(5-benzyl-3-furyl) methyl 2,2 dimethyl-3-(2-methylprophenyl) cyclopropanecarboxylate
stirofos	Rabon	2-chloro-1-(2,4,5,-trichlorophenyl) vinyl dimethyl phosphate

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30M—11-79—45722—RES

Cooperative Extension Service. 1981 Insect Pest Management Guide - HOME, YARD, and GARDEN (Revised annually). Urbana, IL: Cooperative Extension Service, Circular 900, 1981.

Turf Tips for the homeowner
Extension Bulletin E-1490 File 29.22 March 1981

Sodding A Lawn

By Greg Patchan, Thomas M. Smith, Paul E. Rieke and Kenyon T. Payne
Department of Crop and Soil Sciences

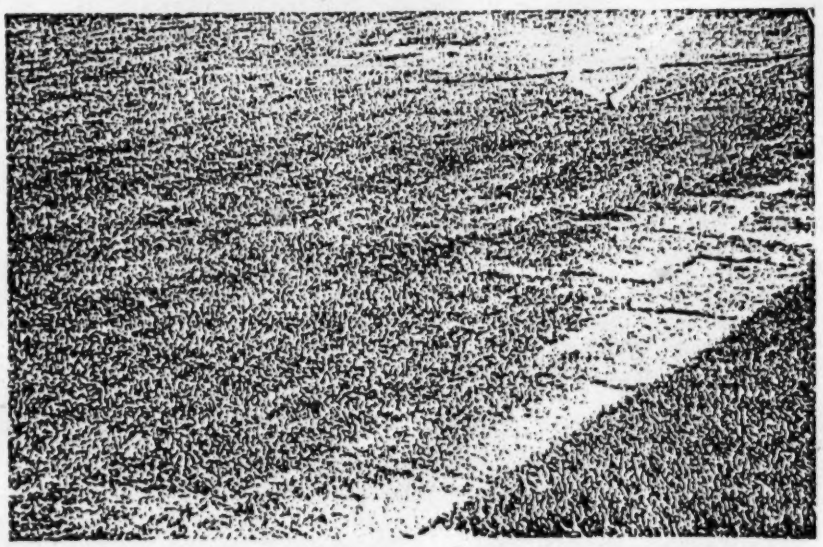
Using sod to establish lawns is a common practice. When compared to seeding, sodding offers both advantages and disadvantages that should be considered.

Advantages are:

1. Fast establishment.
2. Sod can be laid any time soil can be prepared.
3. Better establishment on high use areas.
4. More dependable results on banks and slopes where erosion is a problem.

Disadvantages include:

1. Higher cost.
2. A limited number of grass cultivars available as sod.
3. Limited availability of sod with grasses adapted to shady locations, heavy traffic or utility areas.



Improper watering of sod results in poor establishment.

Site Preparation

Proper site preparation is important in the establishment of a lawn. Prepare the site for sodding as you would for seeding. For detailed information on site preparation, refer to Extension Bulletin E-1401, "Site Preparation for Lawn Establishment." The suggestions which follow provide an overview of the preferred practices.

Weedy perennial grasses, such as quackgrass, tall fescue, and bentgrass, should be killed before an area is sodded. Tilling alone will not eliminate these undesirable species. Use a suitable herbicide to eradicate these weedy grasses.

For a high quality lawn, extensive and deep rooting is important. For this, porous, well-drained topsoil with good water-holding capacity is desirable. How much is enough? The more, the better — from a minimum of 3-4 inches to a preferred 6 inches. If an adequate depth of topsoil is not already spread on the site, additional topsoil can be purchased. Avoid using topsoil contaminated with troublesome weedy grasses such as quackgrass. Do not use fine textured, dark muck as a topsoil because, being an organic soil, it breaks down too quickly. Good topsoil need not be black in color.

Do not simply apply a thin layer (less than 3 inches) of topsoil without tilling into the soil below. A shallow layer becomes a barrier to rooting and drainage, making it difficult to maintain a healthy lawn.

If adequate topsoil is not available, there are alternatives for improving sandy soils or clay subsoils. Sandy soils have a low water holding capacity that can be improved by working 2-3 inches of loamy topsoil or fibrous peat into the soil to a 6 inch depth. Fine textured clay sub-soils present a more common and difficult problem. These soils compact easily and are not favorable for root development. To improve these soils, apply 2-3 inches of sandy topsoil or 2 inches each of coarse sand and fibrous peat and mix into the existing soil to a 6 inch depth.

If topsoil or amendments (sand, peat) are not used, the existing subsoil should definitely be loosened to a 4 to 6 inch depth. Grading and traffic on the site often leaves the soil highly compacted and undesirable for sodding. Tilling the soil will reduce

this compaction and improve root growth. Before tilling the soil, be sure it is dry enough to work without forming clods. The site can be tilled in much the same way as when preparing a garden. Break up large clods and remove sticks, stones and other debris.

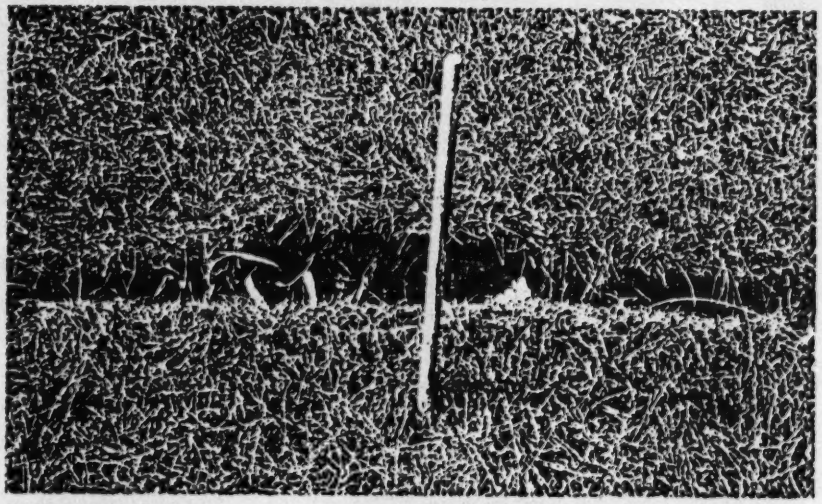
Fertilizer and lime should be applied according to a soil test available from your county Cooperative Extension Service office. If soil tests are not available, apply 10 to 15 pounds of 5-20-20 or 6-24-24 per 1000 square feet. Do not use lime unless indicated by a soil test. Incorporate this fertilizer into the upper 3-4 inches of soil. Complete the preparation process by smoothing the surface. Pay special attention to firming the soil over pipes and tile lines. Water thoroughly and allow time for settling, with the finished grade about 1½ to 2 inches below walks and drives.

Sod Selection

Sod should be free from weeds and weedy grasses (bentgrass, quackgrass, tall fescue) and should contain species and cultivars recommended for the location to be sodded. Most sod grown today has been selected for higher quality lawns in sunny locations. Usually blends of improved bluegrasses are grown and respond well to watering and fertilization. Blends of several cultivars also provide improved disease resistance when compared to a single cultivar. A few growers provide sod adapted to shady or utility areas. If your needs for sod are unique, be sure to inquire about adapted sod. For more information refer to Turf Mimeo No. 1, "Recommended Turfgrass Species and Cultivars for Michigan." This can be obtained from your county Cooperative Extension office.

Sod Installation

The grass plants in sod produce heat that cannot be dissipated when the sod is rolled or stacked for too long. This heat may kill the sod. To prevent this damage, the sod should be laid within 24 hours of its harvest during warm weather, and always within 48 hours.



Sod can be staked to prevent slippage off of a slope,, In this case the sod was stretched during installation and gaps were formed once the sod dried.

Sod can be laid nearly any time of the year if the soil is dry enough to allow soil preparation. Problems may exist with early winter sodding because the sod may dry out and die if the roots are not established before the ground freezes. Sodding should not be done during dry periods if watering is not possible.

Avoid laying sod on powdery, dry soil. A soil that is moist to a depth of 6 inches, but not saturated, allows the new roots to establish rapidly. The ends of the sod pieces should be staggered to prevent lines across the turf caused by slow establishment at the edges. Make sure that the edges of the sod are in good contact with each other but not overlapping. Avoid stretching the sod or gaps will develop between the pieces when the sod drys. Once the sod is laid, roll to insure good contact with the soil. Roots will dry out rapidly if air pockets are left between the sod and the soil. If sod is laid on a slope, it may be necessary to peg the sod strips with wooden stakes to prevent slippage.

Thoroughly water the sod immediately after rolling. As a general rule, uniform watering will be necessary every day to keep the sod moist until the roots have grown into the soil. It is best to water the sod during mid-day to obtain rapid establishment. Be sure to apply enough water to wet the soil under the sod. Rooting normally requires two to three weeks. Once the sod is established, watering can be reduced gradually to once a week or less, depending on when the grass begins to wilt.

Mowing should begin when required by the growth of the grass. The recommended mowing height for bluegrass sod is 1½ to 2½ inches. Avoid removing more than 1/3 of the leaf surface at any one mowing.

After the sod is rooted, follow a fertilization program suggested for established lawns. Generally four fertilizer applications per year are suggested for higher quality lawns. Once the sod is established, good management practices will be necessary to maintain a high quality turf.

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Turf Tips for the homeowner
Extension Bulletin E-1688 File 2-22 March 1981

Watering A Lawn

By Greg Patchan, Thomas M. Smith, Paul E. Rieke and Kenyon T. Payne
Department of Crop and Soil Sciences

Water is essential for all living organisms, including grass. Water is necessary for many plant processes but it is especially important for transpiraton—the evaporation of water from the leaf surface which allows cooling of the plant. Green grass is about 90% water.

During normal summers in Michigan, rainfall is not sufficient to keep a lawn green. Grass then becomes dormant, turns brown and growth stops. The lawn normally recovers when adequate moisture becomes available. If a prolonged drought occurs, some plants will be killed.

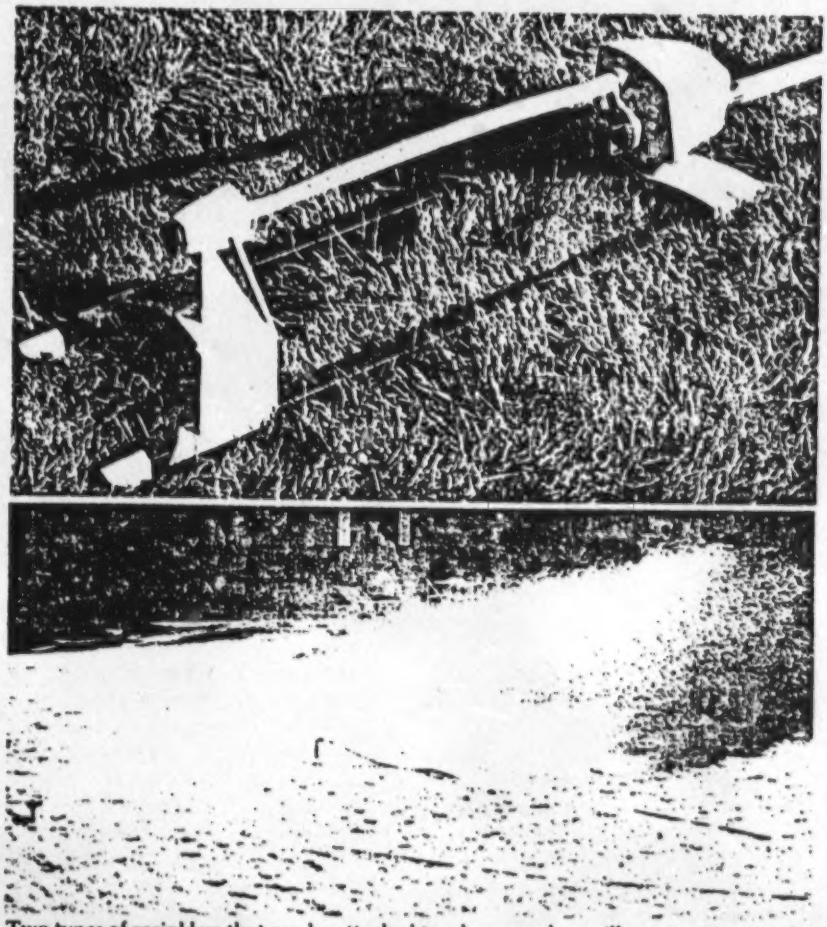
There are both advantages and disadvantages in allowing a lawn to go dormant.

Advantages are:

1. Reduced mowing and fertilizing as growth slows or ceases.
2. Minimal costs for water and irrigation equipment.

Disadvantages are:

1. More weeds due to lack of competition.
2. Slow recovery from additional stress such as traffic, disease or insect attack.
3. Aesthetics—a brown lawn is less attractive than a green lawn.



Two types of sprinklers that can be attached to a hose are the oscillator type (top) and the rotary impact (bot.).

As summer approaches, you should determine whether watering will be practical. Plans should be made for watering if a dense, green, vigorous lawn is desired.

If the lawn is to be watered, decisions must be made on how often, how much, and when to water. A given watering program cannot be applied to all lawns. Varying soil types, exposure, slope, weather conditions, and availability and cost of water and equipment must be considered. The following guidelines will help to maintain a desirable lawn quality, and avoid wasting water.

When to Water

The best time to water is early morning so that the lawn will have water during the heat of the day. Watering at mid-day is not harmful, but is less efficient because evaporation is often high, and wind conditions may cause uneven water distribution. Reduced water pressure may also be a mid-day problem.

Another efficient time for watering is in the evening or at night. Although wet conditions lasting through the night have been thought to increase disease problems, this is

usually not a concern on home lawns. For many homeowners, the evening is the most practical time to water, though water pressure may be low at this time.

Irrigation Equipment

A vast array of watering systems and equipment is available. Selection should be determined by:

1. Budget
2. Lawn area (size)
3. Quality of lawn desired
4. Convenience

A hose and a spray nozzle are the least expensive. However, this approach is suitable only for small areas or light applications because uniform coverage is difficult with hand watering. Approximately two hours are normally required to apply an inch of water to a 1000 square foot area.

A sprinkler attachment is the usual choice for most homeowners. Most sprinklers are a variation of either a rotary or wave-form (oscillator) design. Such equipment is reliable and readily available at a reasonable cost. A drawback on large lawns is that timing the application of each area and moving the hose can be inconvenient. For narrow sites and steep slopes, a soaker hose is a suitable choice. This will avoid wasting water on driveways and sidewalks, although considerable time will be needed to apply the water.

The most convenient and effective method of watering is provided by an underground sprinkler system. For best results, the system should be designed and installed by a trained specialist. Manual or automatic controllers can be used to activate the system, and periodic checks should be made to insure proper performance. An underground system is relatively expensive but frequently adds to the value of a homesite.

Water Frequency

For best results, start watering before grass dormancy develops. Look for signs of wilting. A dark, blue-green color and footprints that persist for some time are signs that a lawn needs water. Once a watering program is started, it should be continued throughout the dry period. If a lush, fertilized lawn is not watered, and no rain occurs during hot weather, serious thinning and slow recovery can result.

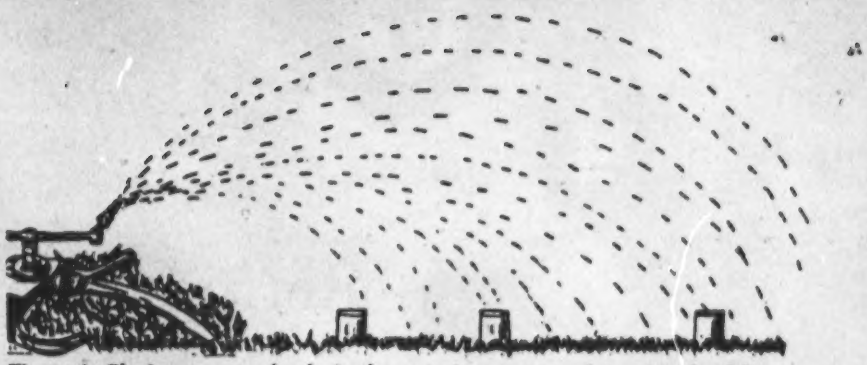


Figure 1. Placing cans randomly in the watering area can determine the delivery rate of the sprinklers.

When wilting is observed, apply enough water to wet the soil throughout the entire root zone. For bluegrass lawns on non-compacted, porous soils, this zone is usually 4 to 8 inches deep. Since lawngrasses require 1.0 to 1.5 inches of water per week, watering, plus rainfall, should supply this amount. An application of 640 gallons of water on 1000 square feet of lawn equals one inch.

Soil characteristics and natural rainfall determine the amount of water needed and the frequency of application. For example, a sandy, porous soil will hold no more than .5 inch of water in a six inch depth. If this amount of water is applied twice per week, the water lost from the root zone is fully replaced. A clay soil holds about one inch of water in the normal root zone. This can be replaced by a single, gradual application of one inch of water.

To determine the delivery of a sprinkler system, place cans of equal height randomly in the watering zone. When the water reaches the desired level in the cans, the sprinkler may be shut off and moved to the next area. This approach will insure that the entire root zone is moistened (Fig. 1).

The amount of water applied and the frequency of application is important. Avoid frequent, light waterings, as this practice promotes shallow rooting. Deep watering will promote the development of an extensive root system. Excessive watering results in wasted water and fertilizer, and may increase weeds and disease problems. Bentgrass, annual blue grass and rough bluegrass may also increase in overwatered lawns.

Special Considerations

Some areas in a lawn may dry more quickly than others. South and west exposures, sandy areas, slopes and areas near buildings, curbs and sidewalks are common examples. These areas may need more frequent watering to meet the needs of the grass, whereas low spots, north exposures, and shady areas may not need watering as frequently. Grasses with poorly developed root systems caused by compacted soil, insect damage or *Fusarium* blight also need special attention. These conditions result in shallow rooting. The result is a reduced reservoir of soil moisture and nutrients available to the grass plants. To compensate for this problem, more frequent watering at reduced application rates will be required. A lawn infected with *Fusarium* blight may require daily watering to prevent moisture stress, but always apply enough water to wet the root zone.

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O-12765

Turf Tips for the homeowner

Extension Bulletin E-1187 File: 9-22 March 1981

Mowing A Lawn

By Thomas M. Smith, Greg Patchan, Kenyon T. Payne, and John E. Kaufmann
Department of Crop and Soil Sciences

Proper mowing is important for maintaining a healthy, well groomed lawn. Mowing should provide a uniform, aesthetically pleasing surface, while improving the density of the turfgrass stand by increasing the development of tillers and leaves. Although high density discourages weed invasion, the actual mowing process also inhibits development of many weeds.

Height of Cut

Turfgrasses are well adapted to frequent mowing, if not cut too short. The grass blades manufacture carbohydrates for the entire plant. When leaf surface area is reduced, a lower level of carbohydrates will be produced. As cutting height is lowered, the root system of the plant is reduced. With a reduced root system, the plant takes up smaller amounts of water and nutrients. A compromise must be reached where the area still looks well-groomed and dense, and is also healthy and actively growing.

The turfgrass species and cultivars growing in the area are the most important factors to consider when selecting the height of cut. For example, creeping bentgrass has many of its leaves oriented horizontally. At low heights of cut (under ½ inch) creeping bentgrass produces adequate leaf tissue to support the rest of the plant. This allows for shorter mowing such as practiced on a golf green. Kentucky bluegrass, fine-leafed fescues, and improved perennial ryegrasses have a more upright growth habit. These lawngrasses should be cut between 1½ and 2½ inches for maximum health of the grass plants.

Infrequent mowing shocks the grass and leaves excessive clippings that must be removed.

At higher cuts, lawngrasses also will be more stress tolerant. There is little need to vary the cutting height during the summer or prior to winter. Shady areas should be mowed at 2½ or 3 inches to obtain the maximum leaf surface.

Mowing Frequency

A general "rule of thumb" in determining mowing frequency is never to remove more than ⅓ of the total leaf surface at any one mowing. This may require mowing twice a week in the spring, every two weeks in the summer and once a week in the fall. If more than ⅓ of the total leaf surface is removed, the grass may be stressed. Scalping may occur if most of the green leaf area is removed. When scalped, the lawn will appear brownish or yellowish because all that remains are the stemmy parts of the plant. If an area is scalped too frequently, the grass may die. Scalping often occurs on uneven lawn areas and rolling terrain.

Clipping Removal

Excessive accumulation of clippings from infrequent mowing may shade and smother the grass if not removed promptly. When the lawn is mowed frequently, with less than ⅓ of the total leaf surface removed, grass clippings can be left on the lawn. Grass clippings are made up of leaf blades that contain mostly water. Clippings break down very rapidly and do not contribute significantly to the thatch layer. By re-

turning grass clippings, nutrients in the leaves are recycled, and therefore reduce fertilizer needs of the lawn.

It may be desirable to remove clippings in some circumstances. On golf putting greens or around swimming pools, clippings may interfere with putting or may get into the pool. Evaluate the particular use of the turfgrass area to determine whether clippings will interfere with the planned use. In most cases, clippings can be returned without problems.

Mowing Equipment

The key to a quality cut is to use sharp, well adjusted mowers. Dull, poorly adjusted equipment tears rather than cuts the grass, leaving a ready site for disease invasion and giving the lawn a frayed, brownish look. The mowing direction should be varied each time to distribute the wear pattern. The grass should not be wet when mowing. Dry grass will cut more cleanly, and the clippings will tend to disperse rather than clump up and clog the mower. The rotary mower and reel mower are the two most common designs of mowing equipment. Each has its advantages and disadvantages, although the rotary mower is much more commonly used.

Rotary mowers are less expensive and easier to maintain than reel mowers. Rotary mowers readily cut coarse grass or tall weeds, and the simpler design requires less adjustment for proper operation. Any mower is dangerous and care should be taken to keep feet and hands away from the blades. Rotary mowers can discharge rocks, glass and other debris. Be certain the lawn is cleared of all debris prior to mowing. Dull rotary blades will still cut the grass, but should be kept sharp for best results. Blades are easily sharpened and should be ground several times a season. It is important that the blade be balanced following sharpening. Sharp blades permit cutting at the lower speeds which improves the safety and energy efficiency of the mower. A mulching mower is a type of rotary mower that finely chops the clippings. The finer clippings filter down through the grass to the soil-thatch surface where they rapidly decompose. Mulching mowers also pulverize a light covering of leaves, adding some extra nutrients to the soil.

Reel mowers are most effective for high quality turfgrass areas. When properly adjusted, a very high quality cut is possible. Reel mowers are more complex to maintain and operate than rotary mowers. Frequent mowing is necessary because reel mowers will not effectively cut tall grass. A light, uniform contact between the bedknife and reel must be maintained. This is a critical adjustment that should be checked before every mowing. Reel mowers require professional sharpening at least once per year, and more frequently if the blades are damaged.

The plastic string trimmer is another type of mowing equipment. Electric or gasoline units are available. Trim-work is easy with string trimmers. Whirling plastic twine cuts the grass around trees, fences and other hard to reach areas. Most models designed for the homeowner operate at low enough speed to prevent any type of serious injury. Goggles are recommended, especially when using heavy duty, industrial models. The nylon string can injure the lower trunks of small trees with thin bark and shrubbery, so care should be exercised.

The edger is another common lawn maintenance tool. Gas, electric or manual types are used to form a clean edge between walks, drives, curbs and the lawn areas. A vertical, rotating blade provides the cutting action.

Mower Safety

Mowing should be done regularly and carefully to protect the health of the grass and the safety of the operator. The following safety tips should be observed:

- pick up all debris before mowing
- keep children or pets away from mowers
- wear sturdy shoes; tennis or jogging shoes provide little protection
- wear long pants to prevent debris from hitting the legs
- always push the mower
- be familiar with the control and operation of the mower
- never put hands or feet near the discharge when the engine or motor is running
- be sure feet are away from the mower blade when starting the engine
- refuel the mower only when the engine is shut off and is cool
- clean and maintain the mower with the spark plug wire detached
- wear goggles when operating string trimmers or power edgers
- operate at low speed whenever possible to conserve gas and improve safety
- don't leave a running mower unattended.

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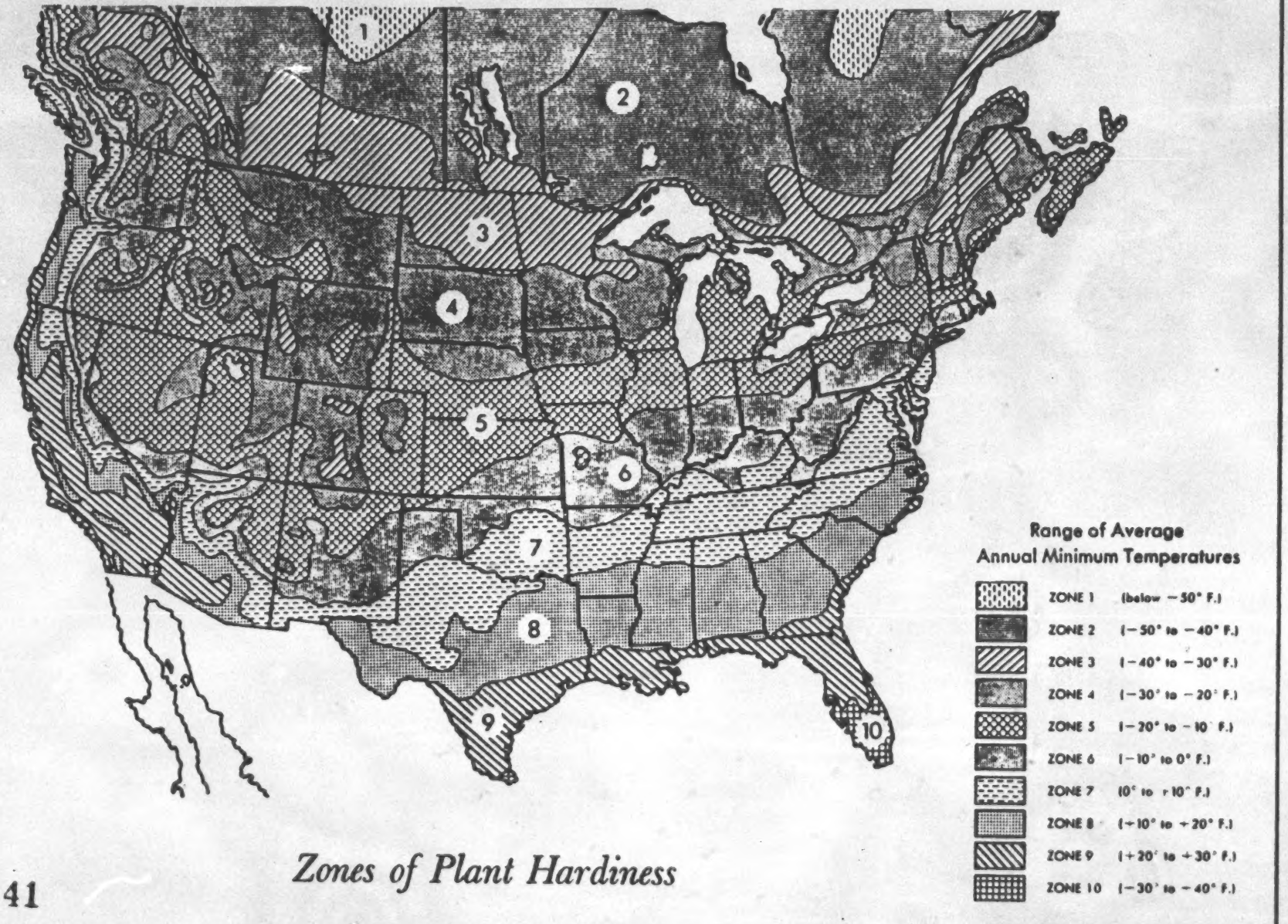

Zones of Plant Hardiness

41

42

W. R. Nelson, Landscaping Your Home (Rev. ed.), Urbana, IL: Cooperative Extension Service, Circular 1111, 1975.

MANAGEMENT PRACTICES THAT HELP PREVENT LAWN DISEASES

These practices are general guides to be used according to one's judgment. Their importance depends on the kind and seriousness of the disease threat. Not all of them are practicable under all conditions.

- Select grass species best adapted to the soil, climatic, and light conditions under which they will be grown.
- Plant mixtures of recommended grasses. Species vary in their susceptibility to different disease organisms, and in a mixture one or more of the grasses usually will survive a severe disease attack.
- Do not clip upright-growing grasses such as Kentucky bluegrass and red fescue too closely—1¾ to 2 inches is the best height. Creeping grasses such as bentgrass and zoysia may be clipped at ½ inch or less.
- Mow the grass before it gets too tall; not more than one-half of the leaf surface should be removed at one time.
- Mow the lawn frequently enough in the fall to prevent the accumulation of a thick mat of grass before snow comes.
- Apply enough fertilizer to keep grass vigorously growing, but avoid overstimulating the grass with nitrogen. Apply lime if soil tests indicate a need for it.
- Clippings need not be removed except on heavily fertilized lawns or during periods when the grass is growing rapidly. Clippings provide nutrients for fungi and help to maintain humidity long after the sun has dried off surrounding uncovered areas.
- Water early enough in the day to allow grass leaves time to dry out before night. Avoid frequent, light waterings, especially during warm weather.
- Do not water grass until it begins to wilt, then soak the soil to a depth of 6 inches or more. Provide good surface drainage.

Science and Education Administration. Lawn Diseases - How to Control Them (Revised). Washington, D.C.: U.S. Government Printing Office, Home and Garden Bulletin 61, 1979.

MAINTAINING THE LANDSCAPE

Student Skills Check List

		Max. Score	Your Score
1.	A saucer formed around shrubs and small trees to hold the water flow.	____	____
2.	Trees/shrubs given 1-2" water.	____	____
3.	Mulch spread evenly and watered to prevent blowing away.	____	____
4.	Wooden separators used to prevent or redirect rubbing branches.	____	____
5.	Major scaffold branches spaced at least 8" apart.	____	____
6.	Necessary safety precautions were taken before pruning initiated.	____	____
7.	Old wood, dead and diseased wood, and wood distorting the natural shape was selectively removed from the tree.	____	____
8.	The proper mower was selected for the given grass.	____	____
9.	The mower was thoroughly checked before used.	____	____
10.	The lawn area was prepared before mowing (rocks, cans, glass, etc. picked up)	____	____
	Total	====	====

WORKSHEET

Maintaining the Landscape

Determine what should be done in each of the following cases.

Kentucky Bluegrass is usually cut at 2" on residential lawns. It is 4" long now. Only 30% of the blade should be removed at one time.

1. How much leaf blade can be removed initially? 1 2/10"

2. What will the height of the lawn be after the first cutting? 2 8/10"

3. Two days later another cut is done. How much leaf blade is removed (consider that there has been no appreciable growth since last cut)? 8/10"

4. What is the height of the lawn after the second cut (nearest whole number)? 2"

5. In order to keep the lawn at 2" at about what height must grass be cut? (nearest whole number) 3"